IEEE SYSTEMS ENGINEERING MANAGEMENT PLAN (SEMP) TEMPLATE*

1. Scope

Includes a brief description of the purpose of the system to which the SEMP applies and a summarization of the purpose and content of the SEMP and how its configuration will be managed.

2. Applicable Documents

Lists all government, ISO, industry, enterprise, project, and other directive documents applicable to the conduct of the tasks within the SEMP.

3. Systems Engineering Process and Application

Describes the tasking/performing activity's systems engineering process activities as they are to be applied to the total engineering effort of the project. And the organizational responsibilities and authority for systems engineering activities, including control of supplier engineering. Descriptions include the tasks needed to satisfy each accomplishment criteria identified in the systems engineering master schedule (SEMS) and the milestones and schedules of the systems engineering detailed schedule (SEDS) for the project. Descriptions include narratives, supplemented as necessary by graphical presentations, detailing the plans, processes, and procedures for the application of the systems engineering process.

3.1 Systems Engineering Process Planning

Briefly describe an overview of the key project technical objectives, deliverables and results from the process, needed process inputs, and product work breakdown structure development.

3.1.1 Major Deliverables and Results. Describe in detail the major technical deliverables and results both to the customer and internal within company x as a result of the systems engineering process activities.

3.1.1.1 Integrated Data Base—Describe the implementation of the decision data base. Include a description of how information will be captured, traced, and maintained. Provide a description of [he provisioning for design capture data/schema to include domain models (processes, technologies, etc.); Product models (physical prototypes - location, availability, characterization, etc.); Archival data (lessons learned, past designs, empirical data); requirements, goals and constraints; project management models (cost, schedule and risk); integrated views, multiple views, and multi-disciplinary designs and their rationale; trade studies and system/cost effectiveness analysis rationale and results; verification data; and product and process metrics.

3.1.1.2 Specifications and Baselines—Describe how the generation of specifications and baselines will be documented and controlled.)

3.1.2 Process Inputs. Identify the depth of detailed information needed to be able to accomplish the activities (appropriate to the level of development) of the systems engineering process, how needed information will be acquired and how conflicts will be resolved.

3.1.3 Technical Objectives. Describes the technical objectives related to success of the project, system, and system effectiveness (e.g., Customer measures of

* Adapted from: IEEE, (1994), "IEEE P1220, *Standard for Systems Engineering*," Appendix B.

effectiveness (MOEs)). Technical objectives may include those related to the system products and their life-cycle processes.

3.1.4 System Breakdown Structure. Describes how the elements of the system breakdown structure will be developed. The relationship of .the specification tree and the drawing tree with the elements of the SBS and how the system products and their life-cycle processes will be related should be explained. This section should describe for each element of the SBS the methods for development and control of work packages; development of planning packages and their conversion to work packages; sizing of work packages; resource use - including integrated product teams; traceability of changes; cost reporting and its integration to scheduling and critical path identification; and configuration management.

3.1.5 Training. Identifies both internal and external (suppliers/customers) training needed. Includes analysis of performance or behavior deficiencies or shortfalls, required training to remedy, and schedules to achieve required proficiencies.

3.1.6 Standards And Procedures. Describes major standards and procedures that the project will follow. Incorporates implementation of standardization tasking into pertinent sections of the systems engineering process below.

3.1.7 Resource Allocation. Describes the method of resource allocation to project technical tasks. Includes resource requirements identification, procedures for resource control, and reallocation procedures.

3.1.8 Constraints. Describes major constraints on the project. Includes those things the project cannot or will not do. Also includes funding, personnel, facilities, manufacturing capability/capacity, critical resources, or other constraints.

3.1.9 Work Authorization. Describes the method by which work is authorized to be performed within the project. Also describes the method by which changes to work efforts will be authorized.

3.2 Requirements Analysis

Documents the approach and methods for analysis of system product uses, utilization environments, performance expectations, and design constraints and identification of needs, requirements, and constraints related to life-cycle processes. Also documents the approach and methods to be used to define the functional and performance requirements for the following quality factors -- Producibility, Testability and Integrated Diagnostics, Distributability (including Packaging and Handling, Transportability, and Installability), Supportability, Trainability, and Disposability; and for the following engineering specially areas -- Reliability, Maintainability, Electromagnetic Compatibility and Electrostatic Discharge, Human Engineering and Human Systems Integration, Safety, Health Hazards and Environmental Impact, System Security, Infrastructure Support and any other engineering specialty bearing on the determination of functional and performance requirements for the system for the appropriate level of development. Additionally, the approach and methods for evolving system products are described. (note: some areas may impact requirements analysis only after synthesis efforts identify physical solution alternatives. + Some of the descriptive information may be more appropriately covered under other systems engineering process activities.

3.3 Requirements Baseline Validation

Includes the approach and methods to validate that the requirements baseline established from requirements analysis is both upward and downward traceable to customer expectations, project and enterprise constraints, and external constraints.

3.4 Functional Analysis

Includes a description of the approach and methods planned to determine lower-level functions; to allocate performance and other limiting requirements to lower-level functions; to define functional interfaces; and to define the functional architecture. Approaches and methods for the quality factors and engineering specialty areas in 3.2 are also defined.

3.5 Functional Verification

Includes a description of the approach and methods planned to verify that the functional architecture established from functional analysis is both upward and downward traceable to the validated requirements baseline.

3.6 Synthesis

Includes the approach and methods to transform the functional architecture into a physical architecture; to define alternative system concepts; to define physical interfaces; and to select preferred product and process solutions. Describes how requirements are converted into detailed design specifications. Approaches and methods for the quality factors and engineering specialty areas in 3.2 are also defined. In addition, the following areas are included - non-developmental items and parts control.

3.7 Physical Verification

Includes a description of the approach and methods planned to verify that the physical architecture established from synthesis is both upward and downward traceable to the functional architecture and satisfies the requirements of the validated requirements baseline.

3.8 Systems Analysis

Includes an overview of the approach and methods planned to utilize to arrive at a balanced set of requirements and balanced functional and physical to satisfy those requirements and control the level of development dependent outputs of the systems engineering process. Provides an overview of the specific systems analysis efforts needed. Includes methods and tools for trade studies, systems and cost effectiveness analyses; and risk management.

3.8.1 Trade Studies. Describes the studies planned to make tradeoffs among stated requirements, design, project schedule, functional and performance requirements, and life-cycle/design-to-cost. Describes the use of criteria for decision-making and tradeoff of alternative physical solutions. Includes a description of technical objectives, criteria and weighting factors, and utility curves as applicable. Also describes the methods and tools planned to be used and interfaces with the integrated data base.

3.8.2 System and Cost Effectiveness Analyses. Describes the implementation or system and cost effectiveness analyses to support the development of life-cycle balanced products and processes and to support risk management. Describes the measures of effectiveness (MOEs), how they interrelate and criteria for the selection of measures of performance (MOPs) to support the evolving definition and verification of the system includes description of the overall approach for system/cost effectiveness analysis as well as manufacturing analysis. Verification analysis, distribution analysis, operational analysis, supportability analysis, training analysis, environmental analysis, and life-cycle cost analysis. Describes how analytic results will be integrated.

3.8.3 Risk Management. Describes the technical risk program including the approach methods, procedures and criteria for risk assessment (identification and quantification) and selection of the risk handling options and integration into the

decision process. Also describes the risks associated with the development and verification requirements. Identifies critical risk areas. Describes plans to minimize technical risks (additional prototyping, technology and integration verification, evolutionary system development). Identifies risk control and monitoring measures including special verifications, technical performance measure parameters, and critical milestones/events. Describes the method of relating TPM, the SEMS, and the SEDS to cost and schedule performance measurement and the relationship to the system breakdown structure.

3.9 Control

Provides an overview of plans for design capture, interface management, data management, event-based scheduling, calendar-based scheduling, technical performance measurement, technical reviews, supplier control, and requirements traceability.

3.9.1 Design Capture. Describes the approach and methods planned to manage the system definition (configuration) of identified system products and the related life-cycle process products for manufacturing, verification, distribution, support, training, and disposal. Includes a description of change management, configuration control procedures, and baseline management. Describes the design record for alternatives, trade studies, decisions/conclusions, and lessons learned.

3.9.2 Interface Management. Describes the approach and methods planned to manage the internal interfaces appropriate to the level of development to ensure that external interfaces (external to the project or at a higher level of the functional or physical architecture) are managed and controlled. Includes description of change management and the interrelationship with configuration control procedures.

3.9.3 Data Management. Describes the approach and methods planned to establish and maintain a data management system and the interrelationship with the design capture system and decision data base. Includes descriptions of how and which technical documentation will be controlled and the method of documentation of project engineering and technical information. Plans for security and preparation of deliverable data will also be described.

3.9.4 Systems Engineering Master Schedule (SEMS). Describes the critical path methodology and criteria for event transition used to derive the SEMS and supporting systems engineering detailed schedule (SEDS) and their structure. Includes a description of the approach and methods planned to update and maintain both the SEMS and the SEDS.

3.9.5 Technical Performance Measurement. Describes the approach and methods to identify, establish, and control key technical parameters (limited to those that are critical and / or identified by the customer). Descriptions include the thresholds, methods of measuring and tracking, update frequencies, level of tracking depth, and response time to generate recovery plans and planned profile revisions. Described parameters include identification of related risks. Describes the relationship between the selected parameter and lower-level parameters that must be measured to determine the critical parameter achievement value is depicted in the form of tiered dependency trees and reflect the de in to the related system performance requirement (critical parameter). Includes definition of the correlation of each paramour in the dependency tree to a specific system breakdown structure element.

3.9.6 Technical Reviews. Describes the technical reviews and/or audits (system, subsystem, component and life-cycle process,) applicable to the level(s) of development covered by the SEMP. Describes the approach and procedures planned to complete identified reviews and/or audits. The tasks associated with the conduct of

each review, including responsibilities of personnel involved and necessary procedures (e.g., Action item close out procedures) are described. Includes a description of how compliance with the tasking activity SEMP/SEMS and/or this SEMP and performing activity SEMS will be determined; how the discrepancies identified as not meeting SEMP/SEMS requirements will be handled; and how system produce and related life-cycle process products assessed to have a moderate to high risk of compliance will be addressed prior to conducting the review.

3.9.7 Supplier Control. Describes the technical control of suppliers and vendors includes the approach and methods to flow down requirements, manage interfaces, control quality, build long-term relationships, and assure participation on integrated product teams.

3.9.8 Requirements Traceability. Describes how requirements traceability will be implemented. Includes the traceability between systems engineering process activities, system breakdown structures, and correlation, as pertinent, with the SEMS and the SEDS. Describes the interrelationship of requirements traceability with data management and the integrated data base.)

4. Transitioning Critical Technologies

Describes the approach and methods for identifying key technologies and their associated risks; the activities and criteria for assessing and transitioning critical technologies from technology development and demonstration projects internal to the enterprise or from suppliers or other sources. Describes how alternatives will be identified and selection criteria established to determine when and which alternative technology will be incorporated into the product when moderate to high risk technologies are assessed as required to meet functional and performance requirements. Describes the planned method for engineering and technical process improvement, including procedures for establishing an evolutionary system development to enable an incremental improvement approach for system products as technologies mature, or for evolution of the system.

5. Integration of the Systems Engineering Effort

Describes how the various inputs into the systems engineering effort will be integrated and how integrated product teaming will be implemented to integrate appropriate disciplines into a coordinated systems engineering effort that meets cost, schedule, and performance objectives. Brief description of the approach and methods planned to assure integration of the engineering specialties to meet project objectives.

5.1 Organizational Structure

Describes how the organizational structure will support teaming. Describes the composition of teams organized to support a specific element of the system breakdown structure. Also describes major responsibilities and authority of team members by name, and includes present and planned project technical staffing. Includes planned personnel needs by discipline and performance level, human resource loading, and identification of key personnel.

5.2 Required Systems Engineering Integration Tasks

Describes the approach and methods for systems engineering integration tasks such as: technology verification, process proofing, fabrication of engineering test articles, development test and evaluation, implementation of software designs for system products, and customer and supplier engineering and problem solving support.

6. Additional Systems Engineering Activities

Brief description of other areas not specifically covered in sections 1 through 5, but essential for planning a total systems engineering effort. Brief description of additional systems engineering activities essential to successfully engineering a total system solution.

6.1 Long-Lead Items

Describes the long-lead items that affect the critical path of the project.

6.2 Engineering Tools

Describes the systems engineering methods and tools which are planned to be implemented on the program to support systems engineering. Identifies those tools to be acquired and training requirements.

6.3 Design to Cost

Describes the design to cost planning and how cost will be implemented and controlled as a design parameter.

6.4 Value Engineering

Describes the approach and methods planned to address value engineering throughout the development cycle.

6.5 Systems Integration Plan

Describes the approach and methods by which the system is assembled and integrated.

6.6 Interface with Other Life-cycle Support Functions

Describes the approach and methods to assure compatibility with other life-cycle support functions consistent with project and enterprise plans.

6.7 Other Plans and Controls

Describes the approach and methods for any other plans and controls designated the tasking activity or which the performing activity system architect. Systems engineer, or system integrator will use.

6.8 Configuration Management of the SEMP

Describes how this SEMP will be configuration controlled.

7. Notes

Contains any general information that aids in understanding the SEMP (e.g., Background information; alphabetical listing of all acronyms, abbreviations and their meanings as used in the SEMP; glossary of terms used). Explains which of the items in this section are mandatory or are provided for general information.

7.1 General Background Information

Provides background information which will help the implementers and managers of the activities and tasks of this SEMP better understand and accomplish their responsibilities.

7.2 Acronyms and Abbreviations

Provides an alphabetical list of acronyms and abbreviations, and their meanings.

7.3 Glossary

Provides an alphabetical listing of key terms and their applied meaning within the context of this SEMP.

Appendices

Appendices are included as necessary to provide information published separately for convenience in document maintenance. Included would be charts and proprietary data applicable to the systems engineering efforts required in the SEMP. Also included as an appendix would be a summary of technical plans associated with the project. Each appendix should be referenced in one of the sections of the SEMP where data would normally have been provided.